GV Activities in Brazil: Brazilian initiative towards the establishment of GPM-BR Program

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National Network Application
Problems addressed

Statistical Validation over Land

- Comparison between precipitation estimation from different algorithms and measured on the ground by radar and raingauge at different Time x Space scales.

- Evaluation of the precipitation estimation for different regions (precipitation regimes)

- Evaluation of the performance of precipitation estimation algorithms as function of the lifecycle of the precipitation structure

Physical validation
Problems addressed

Warm Clouds – over land

- How to estimate precipitation, over land, from warm clouds?
- How much the warm clouds contribute to the total rain accumulation?
- Can changes in the rain droplets distribution from warm clouds be detected by active/passive microwave radiances?
- Is there a liquid water threshold that determines the beginning of precipitation or does it depend on other physical variables (changes from water cloud to rain cloud)?

Physical validation
Problems addressed

Ice Clouds – over land

- Are there different relationships between Integrated Ice Path and precipitation?
- How can cloud top features and microphysical information help us estimate precipitation ?
- What are the microphysical properties of the typical South America synoptic system and how can this information be useful to estimate precipitation?
- Should the precipitation estimation algorithm include information about lifecycle and precipitation regime?

Project: National Network Application

- Objectives:

  Validate and develop precipitation algorithm (retrieval of bias and analysis of bias dependency), evaluate products (pre and post launch) and characterize convective processes

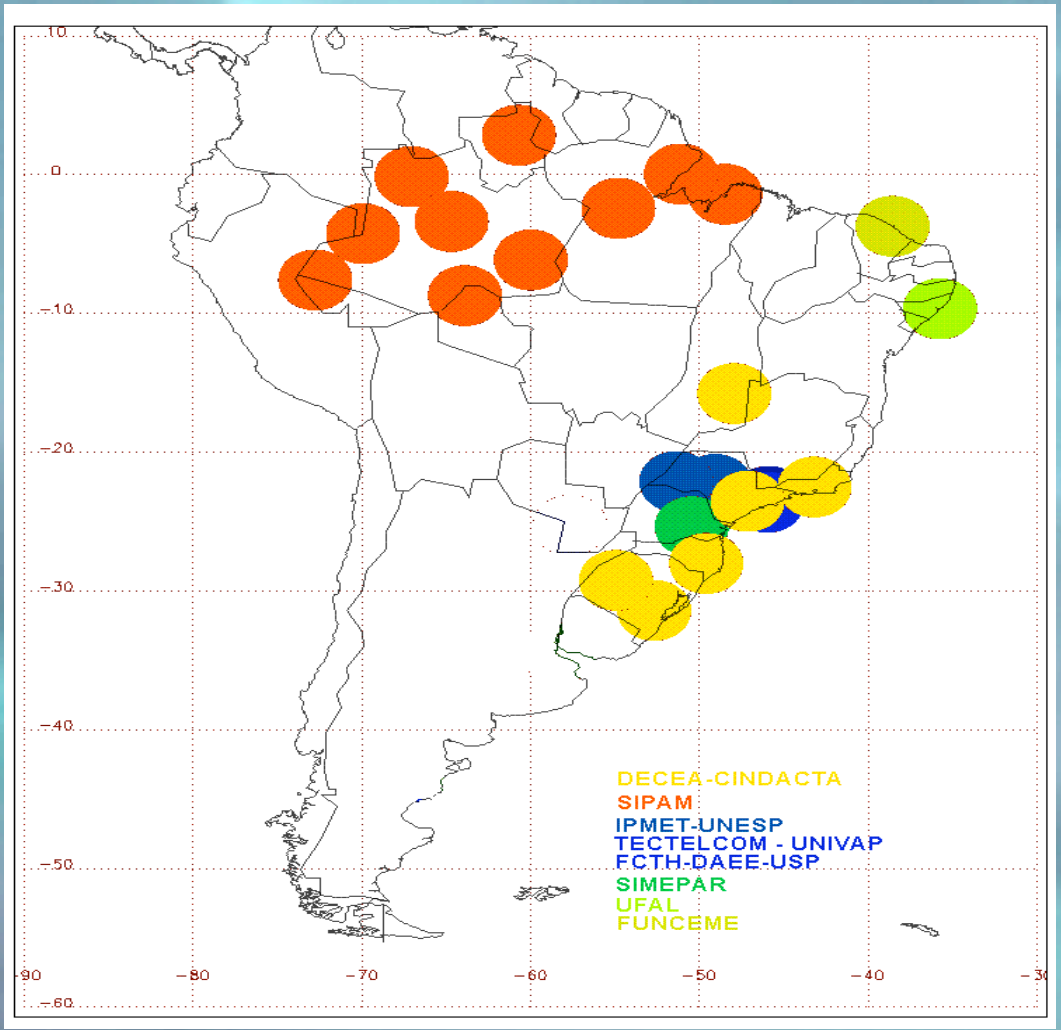
- Potential Collaborating Investigators:

Colorado State University (Chris Kummerow)
University of Alabama/NASA (W. Petersen, M. Schwaller, B. Morris)
LMD – France (Rémy Roca, Nicolas Viltard, Filipe Aires)
NASA - (Ali Tokay)

Resources

- Integrated Brazilian Ground Validation Network;
- Sites in different regions;
- Satellite Radiances

Brazilian Ground Validation network

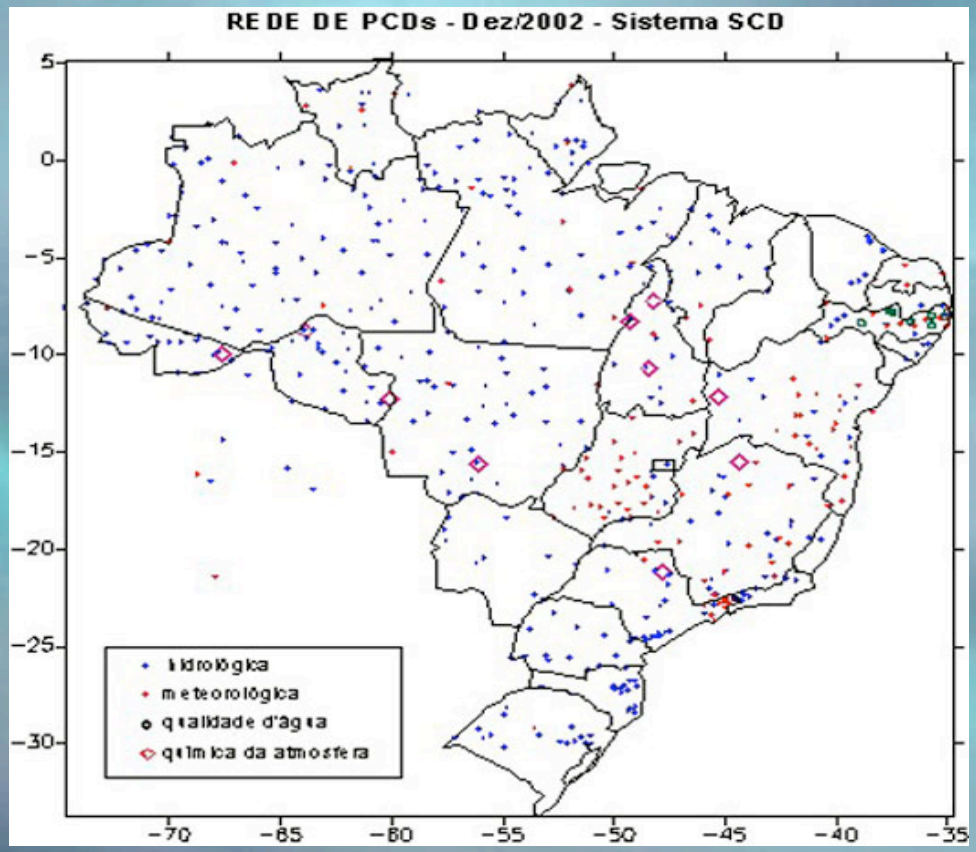


Operational radars in Brazil:

21 - Doppler S-Band
1 - S-Band
1 - Doppler C-Band
2 - Doppler X-Band

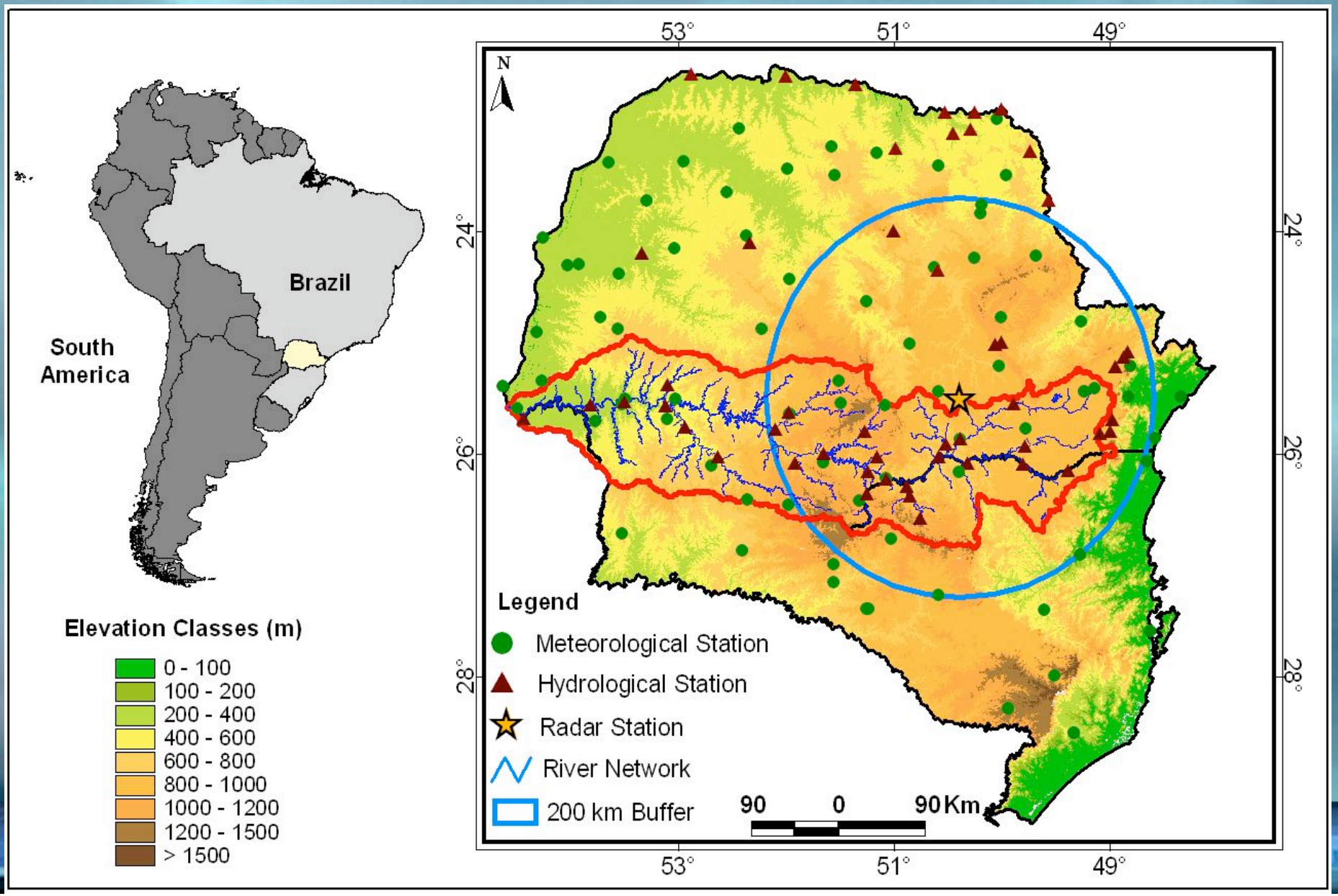
Data already available:
From 9 radars - Volumetric 240 km data are stored every 15 minutes;

Data from automatic weather stations are transmitted to CPTEC-INPE..



Data Available:
Hourly rainfall data

An example of possible GV network for South of Brazil, including AWS operated by SIMEPAR, EPAGRI and INMET

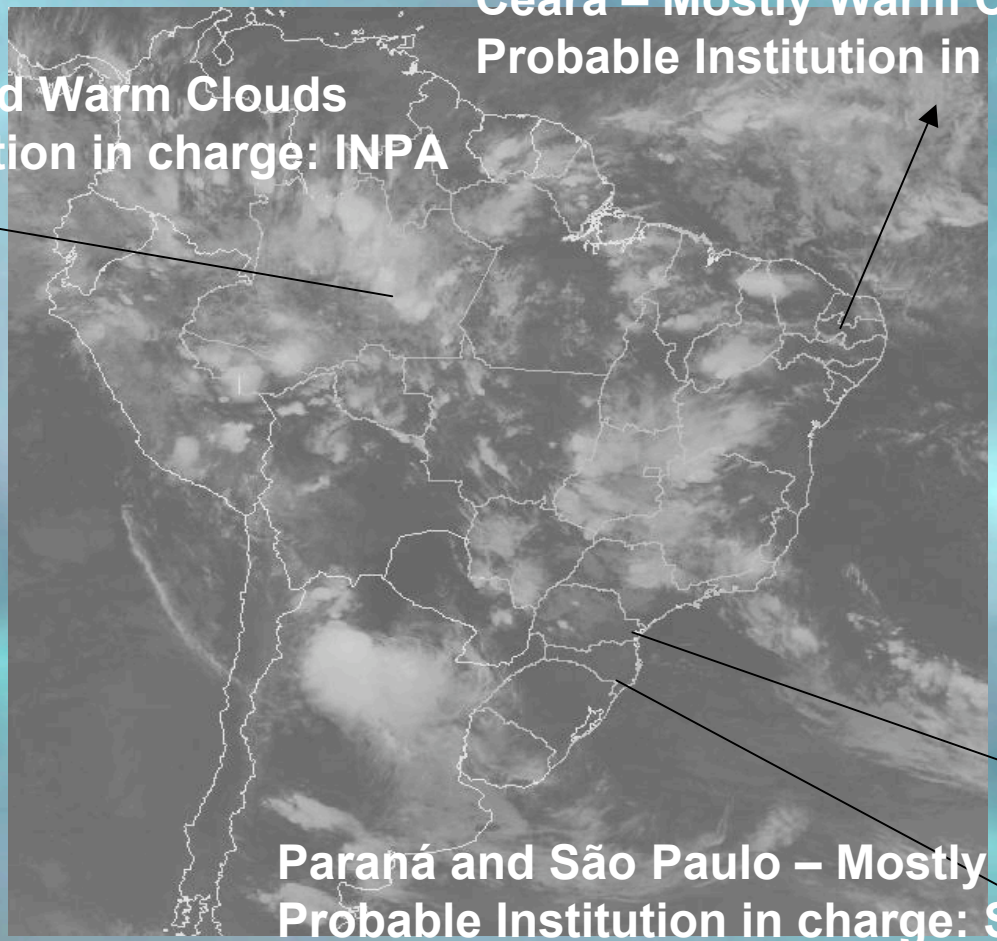


Procedures

- Visit each Brazilian Institution involved in measuring important data to GPM validation. Propose to be part of the Brazilian GPM-GV effort. Make this participation official by the signature of an agreement (a computer is already available to be given to the new participant).
- Create a database and make all this information available to the GPM community.
- Select special sites in different parts of Brazil to improve measurement and collect specific data (disdrometer, microwave radiometer, GPS, soil moisture, mobile radar, sounding and field campaign). The Institutions responsible for each site will sign an agreement that will describe the data policies.
- Develop a quality control system and specific procedures to process the data from each radar.

Several Sites

Possible Validation Sites



Ceará – Mostly Warm Clouds
Probable Institution in charge: FUNCEME

Manaus – Ice and Warm Clouds
Probable Institution in charge: INPA

Paraná and São Paulo – Mostly Ice Clouds
Probable Institution in charge: SIMEPAR and IPMET

Project: Physical Validation

- Objectives:

  Develop algorithms and study cloud processes

- Potential Collaborating Investigators:

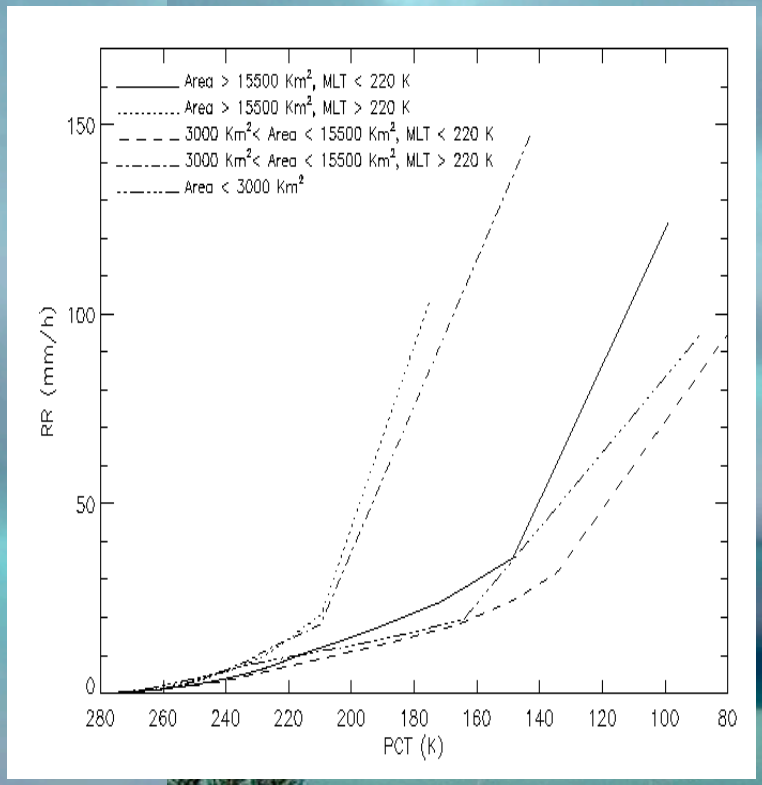
Colorado State University (Chris Kummerow)
University of Alabama/NASA (W. Petersen, M. Schwaller, B. Morris)
LMD – France (Rémy Roca, Nicolas Viltard, Filipe Aires)
Observatoire de Paris – France (Catherine Pringent)
NASA - (Ali Tokay)

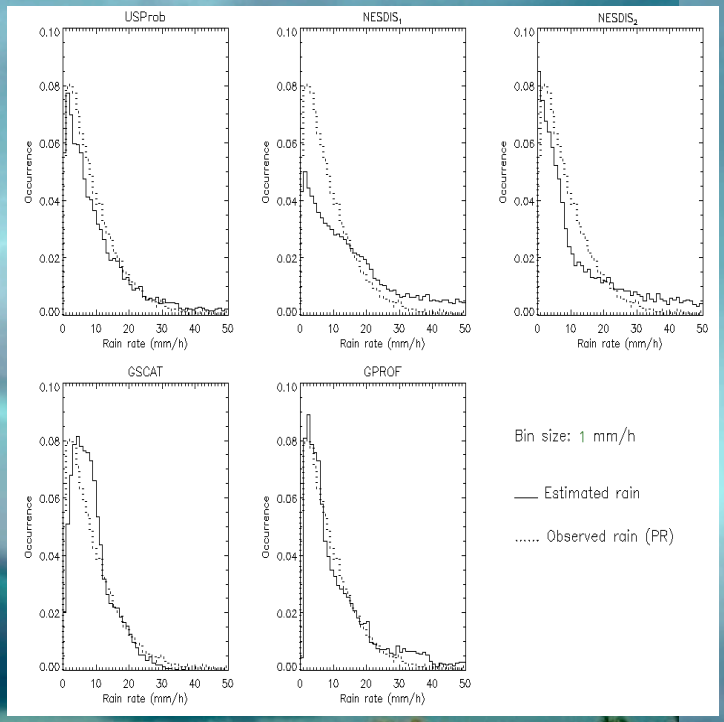
Resources

- Integrated Brazilian Ground Validation Network;
- Sites in different regions;
- Satellite Radiances
- Radiative Transfer Models
- Mesoscale Model with explicit microphysical
- Field Campaigns

Some Recent Results Contributing to address the scientific problems

USProb - A Passive Microwave Statistical Algorithm for Rainfall Retrieval over the Continental Amazon Basin

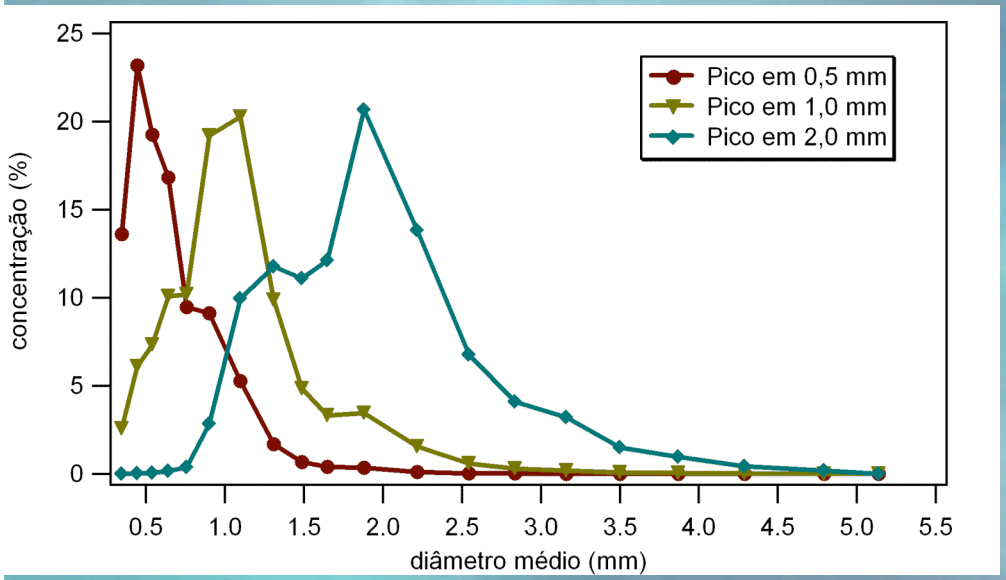


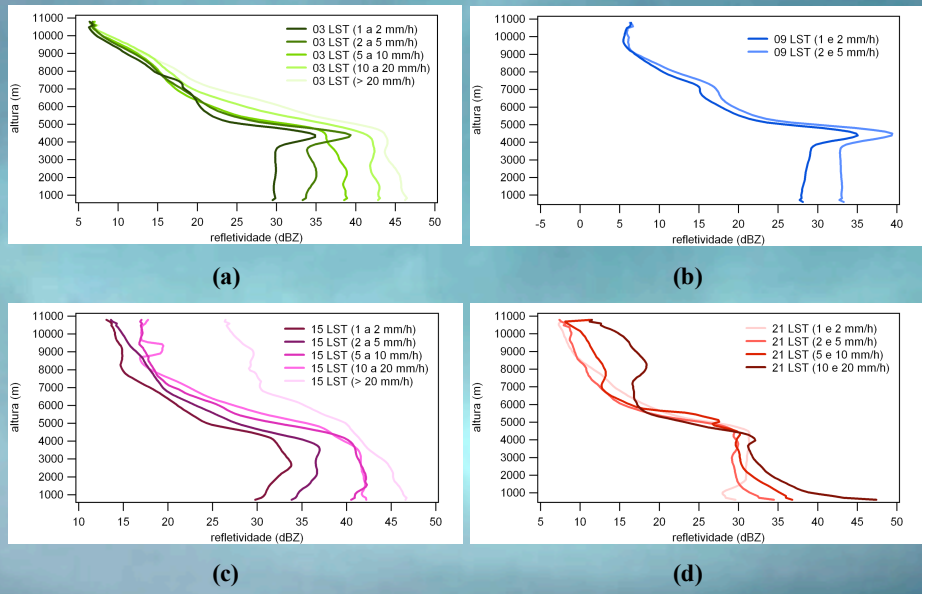


Related paper: Biscaro, and Morales,: Continental Passive Microwave Based Rainfall Estimation Algorithm: Application to the Amazon Basin. *J. Appl. Meteorol. Climatol.* in press 2008.

Some Recent Results Contributing to address the scientific problems

Cloud Droplet Distribution and the Associated Reflectivity Profile



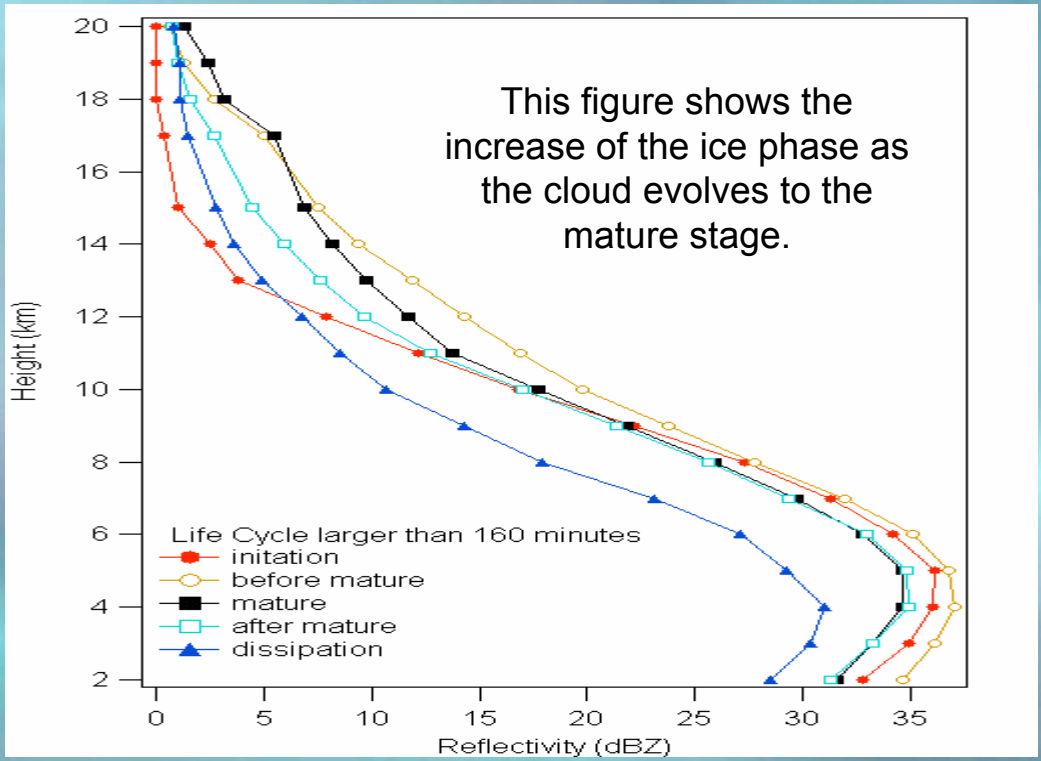


Tri – Modal Distribution was found in the Amazonian region. When collision and coalescence have been established the droplet size distribution reaches the equilibrium state.

Martins and Machado, 2008 to be submitted to GRL

Some Recent Results Contributing to address the scientific problems

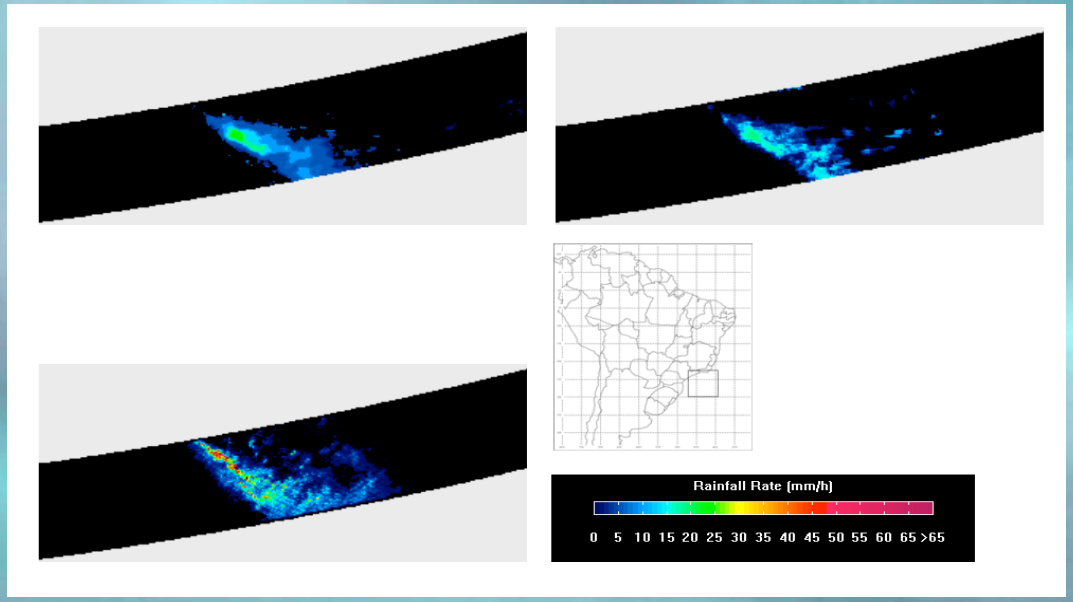
Composite of the reflectivity vertical profile at different lifetimes Weather Radar – S BAND



Related Paper:
Machado, Lima and Vila, 2007, International Symposium in Remote Sensing of the Environment

Some Recent Results Contributing to address the scientific problems

Basis for a Rainfall Estimation Technique Using IR-VIS Cloud Classification and Parameters over the Life Cycle of MCS

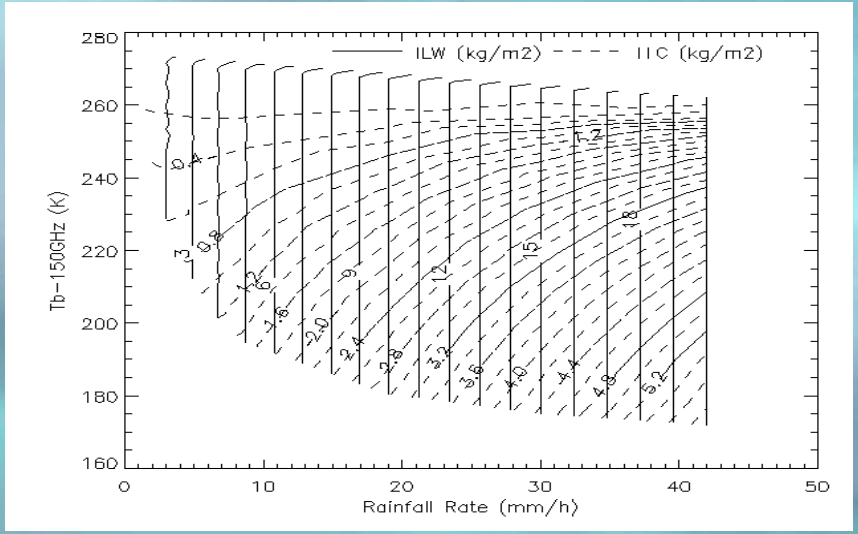


Related Paper– Delgado, Machado, Angelis et all, 2008 – J. App,.Clim.- in press

Some Recent Results Contributing to address the scientific problems

THEORETICAL STUDY: SIMULATIONS WITH SCATTERING EFFECT

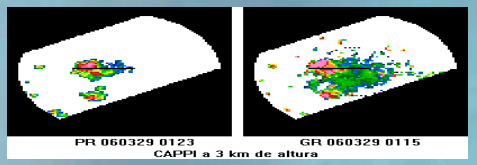
✓ Simulation of 150 GHz brightness temperature as a function of rainfall rate for different values of integrated liquid water (*ILW*) and integrated ice content (*IIC*). Continuous lines indicate the integrated liquid water content, while the dashed lines represent the integrated ice content. The *ILW* varies from 0-20 kg/m2 and *IIC* varies from 0 to 6 kg/m2.

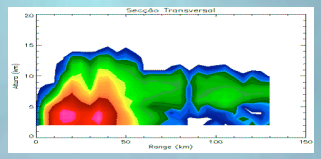


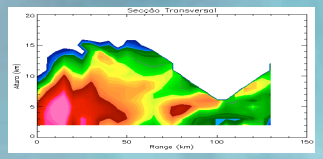
Related Paper:
Lima , Machado, Morales and Viltard `.International Journal of Remote Sensing Vol. 28, No. 16, 20 August 2007

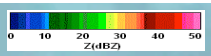
Some Recent Results Contributing to address the scientific problems

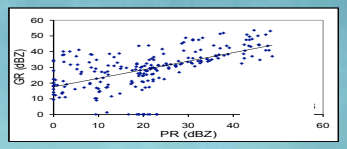
Comparison between TRMM and ground radar

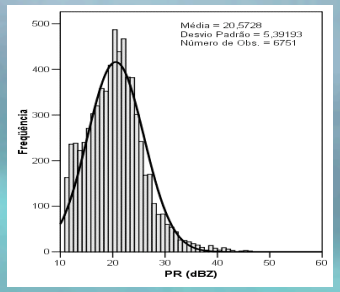


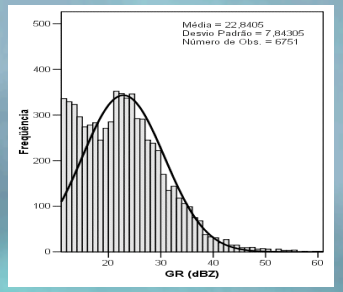


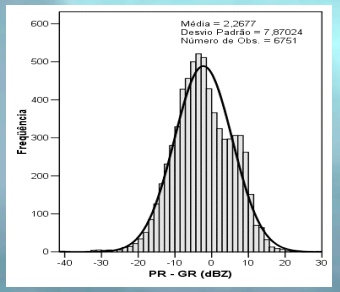












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PR - GR	-2.26773	7.87024	-23.675	6750

$$offset = \frac{1}{n}\left(\sum Z_{PR} - Z_{GR}\right)$$

Master Degree – Carvallo and Angelis

Physical Validation

- Rainfall characterization from different life stages and synoptic regimes. Rainfall PDFs as a function of precipitating systems. Mean drop size distribution as a function of precipitating systems. Mean vertical hydrometeor distributions;

- Use of Radiative transfer model, the RTTOVS-8 and the ATM (Atmosphere Transmission Microwave) coupled with high resolution mesoscale model (BRAMS) to simulate satellite microwave signal for typical Brazilian synoptic regimes. Development of synthetic radiance from radiative transfer model to compare with satellite and ground measurements. This study will allow the development of algorithms and a radiance-convection database to be used in rainfall estimation algorithm.

Physical Validation

- Rain area identification:

  A continuous measurement of temperature, humidity (soundings as well as GPS) and liquid water from a surface microwave radiometer (MP300), a scanning radar, a set of rain gauges and soil moisture measurements under the radar/satellite coverage area (NE Brazil – warm clouds).

- Cloud Physics and the onset of rain.

  The scanning, upward looking radiometer, can retrieve cloud water at the same time that the scanning radar and raingauge can measure precipitation (verify that the retrieval algorithm is correctly partitioning the total water it senses into cloud and precipitation). (NE Brazil – warm clouds).

Physical Validation

- Ice clouds

  Explore how different ice-scattering relationships vary with meteorological regimes, life cycle and cloud top properties (Amazonas and Southeast sites). Explore Tb versus rainfall relationship as determined by the GPM core satellite and relate this to cloud morphology (e.g. cloud lifecycle stage, system classification, location of pixel within the cloud), cloud top features and characteristics and meteorological variables (e.g. atmospheric stability, humidity profiles, wind shear).

Summary

- Several Scientific questions have been presented and continuous effort should be made to answer those questions.
- A procedure will be established this year to choose the sites and Brazilian partners of the GPM-GV efforts.
- Official projects should be prepared between collaborating investigators and Brazilian investigators or GPM-Br office.
- We expect international cooperation in many of the topics. For instance: radar algorithms, hydrological validation, field campaign, PhD programs (sandwich), instrumentation of the sites and scientific projects.